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Methicillin-Resistant Staphylococcus Aureus Infection: Antimicrobial Photodynamic Therapy

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Abstract

The current study's aim was to evaluate the clinical features and treatment of males who have sex with men who have community-associated methicillin-resistant Staphylococcus aureus (CA-MRSA) infections. Patients with MRSA that was culture-proven between November 2004 and December 2005 at Maple Leaf Medical Clinic (Toronto, Ontario) were the subject of a retrospective chart examination. Individual doctors and system queries in the clinical management system were used to find cases. Patient demographics, potential MRSA risk factors, and the course of their disease were all recorded on a standard data collection form.

Methicillin-resistant as one of the main culprits causing nosocomial and community infections, Staphylococcus aureus (MRSA) infection in humans and animals is alarming. Additionally, there are few therapeutic alternatives due to MRSA's slightly rising medication resistance. This study focuses on determining the incidence of MRSA in shrines, an environment where frequent interactions between people and animals might spread diseases, genes, and germs that are resistant to antibiotics. Between March 2018 and May 2018, 120 environmental swabs were collected from specific locations. Gram staining, standard biochemical testing and growth on mannitol salt agar (MSA) were used to identify Staphylococcus aureus and MRSA, respectively. The disc diffusion method was used to assess the antibiotic susceptibility of S. aureus isolates. Methicillin-sensitive S. aureus (MSSA) and MRSA proportions were 19% and 81%, respectively; isolates from Thapathali had a high prevalence of MRSA (28.6%). MSSA isolates exhibited a high level of erythromycin resistance (64.7%). The MRSA isolates tested negative for ciprofloxacin (25%), erythromycin (50%), gentamicin (50%), and cotrimoxazole (25%). Linezolid (100%), clindamycin (100%), ciprofloxacin (75%), erythromycin (50%), tetracycline (100%), and cotrimoxazole (75%), among other antibiotics, were all effective against the isolates. Gentamicin (50% resistance) also exhibited intermediate resistance. Inducible clindamycin resistance (ICR) was present in 6 (54.5%) of the 11 MSSA isolates that were both erythromycin- and clindamycin-sensitive. It was also present in 2 MRSA isolates that were both erythromycin- and clindamycin-sensitive. Only two MRSA isolates produced -lactamase, as opposed to fifteen MSSA isolates that were -lactamase positive. Only a little amount of study has been done on infectious diseases that affect both primates and animals. This study reveals that MRSA/MSSA is widespread in the shrines, which may be a key location for infection transmission between people and monkeys.

Keywords: Methicillin-resistant Staphylococcus aureus; Staphylococcus aureus; Photo chemotherapy; Biofilm; Antioxidant response; Antimicrobial photodynamic inactivation; Antimicrobial photodynamic Therapy.

Introduction

Methicillin-resistant since the late 1970s, Staphylococcus aureus (MRSA) infection has been linked to multiple hospital outbreaks and is a major cause of morbidity and mortality in hospitalised patients around the world. The rising frequency of community-associated MRSA (CA-MRSA), which exacerbates the issue of healthcare-associated MRSA (HA-MRSA), makes it more difficult to choose the best treatment for both HA and CA MRSA infection [1]. Egypt had the highest MRSA rates among clinical isolates of S. aureus in comparison to other African nations and southern and eastern Mediterranean nations. Since the introduction of penicillin for medical use in 1942, Staphylococcus aureus (S. aureus) has been mutating and acquiring antibiotic resistance. Penicillin functions by preventing penicillin-binding protein (PBP), which is essential for bacteria to produce their cell walls. As a result of PBP suppression, microorganisms osmotically perish. A specialised ß-lactamase enzyme called penicillinase, which hydrolyses the antibiotic and renders it useless, was rapidly produced by bacteria. Methicillin, a semi-synthetic penicillinase-resistant drug, was first made as a result of this manufacture. The additional methoxy group that results in an enzyme that lowers the affinity for staphylococcal ß-lactamase distinguishes methicillin's mechanism of action from penicillin's. However, Staphylococcus aureus quickly began displaying methicillin resistance. Methicillin-resistant S. aureus is the name given to these resistant strains that first appeared in the UK (MRSA) [2].

Over the past 20 years, vancomycin has been the mainstay of care for patients with HA-MRSA infections. It is possible that phenotypes with reduced susceptibility to vancomycin (RSV), which have called into doubt the usefulness of vancomycin, were primarily responsible for treatment failure in cases of MRSA infections. Due to its unique pharmacokinetic features, particularly for patients with penicillin allergies, clindamycin, a member of the macrolide-lincosamide-streptogramin B (MLSB) antibiotic class, has emerged as an effective substitute for MRSA infections. As a result, inducible resistance to MLSB antibiotics has spread throughout the world, making it necessary

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to regularly check for this resistance using a straightforward D-test [3].

Materials and Methods

Twelve hospitals in Egypt participated in this on-going prospective cohort research between 2005 and 2013. Patients who developed infections 3 calendar days after being admitted to a medical facility had their healthcare-associated S. aureus (HA-S. aureus) isolates recovered. Staph (12), pus (23), wound swabs (23), urine (19), blood (135), bronchoalveolar lavage (123), endotracheal tube (6), sputum (56), and unidentified sources were all used to isolate S. aureus strains (74) [4].

Through the implementation of a sentinel monitoring programme for acute febrile diseases in 12 infectious disease hospitals in Egypt from 2005 to 2013, community-associated S. aureus (CA-S. aureus) isolates were gathered. These isolates were found in patients who arrived to a medical facility within three days or less with clinical symptoms, indicating community-associated transmission. They were separated from CSF and blood (144). (39). To ensure the standardisation of the methods used and the unification of the antimicrobial discs for susceptibility testing in accordance with Clinical Laboratory Standards Institute (CLSI) guidelines, all isolates. Testing protocols' validity and accuracy were checked using ATCC 25923 [5].

Information about each patient that was clinically and epidemiologically pertinent was gathered from their medical files and patient interviews. Following the recommendations of the Clinical and Laboratory Standards Institute, the disc diffusion method was used to test an organism's susceptibility to antimicrobial drugs. The following antibiotics were put to the test: vancomycin, erythromycin, cefoxitin, Oxacillin, ciprofloxacin, tetracycline, gentamicin, rifampin, trimethoprim/sulfamethoxazole, and clindamycin (Oxoid Ltd., Basingstoke, and Hampshire, UK). As a quality check, S. aureus strain ATCC 25923 was employed. Inducible clindamycin resistance was evaluated using the double disc diffusion test [6].

Discussion

Our two instances from a single medical facility are among 18 cases of MRSA-related prostate infections that have been reported globally. Ages of the cases recorded varied from 29 to 77 years old. 16 of the patients had genitourinary (GU) problems, 17 had prostatic abscesses found during imaging or autopsy, 16 had bacteraemia, 10 had diabetes, and 2 had AIDS. Our first patient is the sole known incidence of an immunocompetent host succumbing to this virus, while the first fatal occurrence was in a patient with AIDS [7].

Prostatic abscess does not yet have any documented therapy recommendations. The remaining fourteen instances were effectively treated with drainage and antibiotic regimens that included vancomycin, daptomycin, doxycycline, rifampin, sulfamethoxazole/trimethoprim, and nafcillin. Of the other recorded cases, two were successfully treated with antibiotics alone. Although linezolid is a suitable therapeutic choice for MRSA urinary tract infections and prostate infections, none of these reported cases involved its use. Our initial case demonstrates the potential aggressiveness of this infection as well as the importance of early drainage and medicines in serious patients [8].

Obstructive uropathy with retrograde urine flow, urethral foreign bodies (such as chronic indwelling catheters and lower GU tract equipment), prostatitis, HIV infection, diabetes mellitus, immunodeficiency states, and bacteraemia are common risk factors and pathways for prostate infections. The autopsy of our first patient, who had a urethral stricture, revealed no evidence of bladder obstruction [9]. We hypothesise that the prostatic abscess and subsequent development of acute bacterial endocarditis were caused by his prior history of a penile furuncle. This hypothetical conclusion is supported by the pathologist's temporal evaluation. If true, earlier, more aggressive prostate abscess treatment might have prevented death. Despite the results of the post-mortem, we cannot completely rule out the likelihood that the penile furuncle was the cause of the endocarditis and bloodstream infection that led to the metastatic prostatic infection [10].

In our second patient, who lacked any typical prostatic abscess risk indicators, haematogenous seeding of the prostate was more likely. Prostatic abscess development is aided by delayed diagnosis, compromised host defence, insufficient antimicrobial therapy, or limited antibiotic penetration into the prostate once the abscess has been seeded with bacteria. The prostate can be infected by MRSA strains that are obtained in both hospitals and the community [11]. Known as USA300 Panton-Valentine leukocidin (PVL) positive (MRSA 300), a novel strain of community-acquired MRSA was first discovered in 2000. In addition to raising the risk of necrotizing pneumonia and other bacteraemia-related sequelae such endocarditis, osteomyelitis, soft tissue infection, renal abscess, and even prostate abscess, PVL is a powerful toxin that gives higher virulence. In two of the reported instances, MRSA 300 was shown to be the etiological agent. Neither of our patients may have had this MRSA strain, as far as we know. MRSA was isolated from 0.8% of 9,985 urine samples in one study, indicating that it is not frequently seen in urine. Similar to prostate infections, variables that raise risk for MRSA in the urine include getting older, having diabetes, visiting a hospital, using a catheter, having genitourinary abnormalities, having bacteraemia, and having pyelonephritis. A look for endovascular infection should be prompted by the discovery of MRSA in the urine [12].

Conclusion

The findings of our study demonstrated a high level of bacterial contamination on regularly used ICU objects and instruments. A potential risk factor for nosocomial infections is the isolation of MRSA and VRSA from the sites. In order to reduce contamination by possible pathogens, the current study underlines the necessity for adjustment in the current cleaning/disinfection techniques. Effective infection control procedures and routine microbiological surveillance of the ICU environment are expected to reduce bacterial contamination and transmission. When staphylococcal infections are detected in ICU patients, gentamicin may be given indiscriminately.

According to the current study, biofilm was generated by MRSA and MSSA strains that were isolated from clinical samples of hospitalised patients. Strains from various clinical samples produced diverse types of biofilm biomass. While strains from wounds and anus produced much less biofilm than strains from bronchoalveolar washings, strains from blood did not significantly lessen the amount of biofilm produced by strains from bronchoalveolar washings. When compared to bacteria isolated from other clinical samples, the ability of faecal strains to produce biofilm was much lower. The MRSA strains' biofilm biomass was substantially higher than the MSSA strains' biofilm biomass. All organisms carried the Ica operon, and those that formed a robust biofilm and carried the icaABCD or icaABD genes produced considerably more biofilm than those carrying the icaAD gene. The ability of MRSA and MSSA strains to build biofilms suggests a high propensity for these strains to survive in hospital settings and raises the risk of illness development in hospitalised patients.

Acknowledgement

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Conflict of Interest

None

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